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T R E N D S



ADOPTING DIGITIZATION AND ITS IMPACT ON SKILLS

A Research Study Commissioned by Supply Chain Canada (SCC) - National

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OUR RESEARCH TEAM

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Drs. R. Bhatti and **S. Kang**.

Dr. Bhatti, the research lead at 2302347 Alberta Ltd., is an experienced supply chain expert who has a keen interest in investigating supply risk in global supply chains, using artificial learning (AI) and machine learning (ML) models towards designing improved SC prediction engines. Interested in advancing the realms of AI & ML in SCM, Dr. Bhatti is the recipient of a number of funded projects (SSHRC/Municipal/Provincial govt agencies) focussed on SC risk management, mitigation, quantification, data analytics, AI & ML. In 2020, Dr. Bhatti was recognized by Supply Chain Canada as one of the Canadian immigrants who have tirelessly contributed to enhancing the supply chain profession and their roles within it.

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Executive Summary

The ongoing conflict between Russia and Ukraine has caused significant disruptions to supply chains across the world. The COVID-19 pandemic has also had a significant impact on global supply chains, causing disruptions to trade and transportation and leading to shortages of essential goods and services. The COVID-19 pandemic has rekindled interest in supply chains and raised awareness of their robustness and resilience. Inflationary pressures were caused by pervasive worldwide supply shortages, pent-up consumer demand, and the reopening of the economy. Alberta experienced one of the worst economic downturns in the past three decades due to COVID-19's effect on oil prices. The global energy commodities market is crucial to Alberta's economic revival, and a \$13.2 billion surplus is expected in the ongoing fiscal year.

This study is an early attempt to examine how adoption of digital skills in Alberta supply chains have evolved, where are we currently sitting on this file, the enablers, and the barriers to the adoption of digitization and what newer skills will be expected of supply chain professionals in times to come. The study also examines some roles in the supply chain sector that may either totally vanish or undergo some evolution. In continuation of the research, this study also explores some new roles in the sector that are likely to emerge as a result of the changes in technology around us, especially the digitalization of modern supply chains. Real-time visibility is a key benefit of digitizing supply chains, allowing for more efficient problem identification and resolution, cost savings and improved productivity.

Companies must continue to invest in technology as a strategic priority, with 61% of businesses believing that technology provides a competitive advantage. Cyber-physical systems, such as smart robots, are becoming increasingly important due to labour availability restrictions, fast-rising labour rates, and the residual implications of COVID-19. Automated network tools, devices, and applications, such as drones, robots, and connected vehicles, rely on edge ecosystems. Wi-Fi, Bluetooth,

and 5G are data communications technologies that will strengthen peripheral ecosystems and supplement centralized supply chain models. By 2026, 80% of businesses that haven't merged their digital supply chain twins and control tower programs will witness a major loss in value.

The National Supply Chain Task Force recommended end-to-end supply chain visibility, accountability, the efficiency of supply chains and security. During the stakeholder consultations, the Task Force heard that funding and incentives for automation would speed up adoption of digital technologies at the organization and sector levels, thereby enhancing competitiveness. The federal government has announced plans to establish a Supply Chain Office to unify the federal government's responsibility/authority over transportation supply chain management across federal departments, develop, implement and regularly renew a long-term, future-proof (30- to 50-year) transportation supply chain strategy, address Canada's significant transportation supply chain labour shortage, make it easier to plan and coordinate transportation activities to alleviate bottlenecks, reduce congestion and be more resilient to disruptions, support industry-driven approaches to digital solutions, support evidence-based decision-making to further optimize existing networks and better plan infrastructure investments, and work with industry to optimize trade corridors and gateways across Canada. Digitalization of supply chains is now being recognized as a solution to many of our supply chain risks, and disruptions, and is being increasingly seen as a step towards designing resilient supply chains.

The study also re-established the knowledge that technical skills are essential for understanding and analyzing data, automating and streamlining supply chain operations, and protecting sensitive data and supply chain operations from cyber threats. These skills include data analysis, visualization, integration and interoperability, continuous learning, and learning and adapting to new technologies. Professionals must be able to identify trends and patterns in supply chain operations and use this information to make informed decisions. They should also have the ability to create data visualizations to communicate findings and insights to stakeholders.

It is clear that data-driven decision-making and predictive analytics are essential for digital supply chains. Data analysis and visualization skills are essential for identifying trends and patterns in data and using this information to optimize supply chain operations and improve performance. Supply Chain Performance Metrics are also important for measuring and evaluating supply chain performance. Communication is essential for effectively communicating data and insights to stakeholders.

Networking and collaboration skills are also essential for effective communication between different stakeholders. Finally, coordination is essential for coordinating the flow of goods and information between suppliers, customers, and partners. Professionals must be able to effectively communicate with internal and external stakeholders, build and maintain strong relationships with these stakeholders, and build trust and understanding with stakeholders.

The study makes it amply clear that there is a need to setup a multiyear, strategic study in this area to understand the province or country wide changes which the supply chain sector needs to be prepared for. Not all sectors within the SCM ecosystem are similar and hence a sector facing study is an immediate and urgent need. The exponential rate at which technologies like Artificial Intelligence, Chat-GPT, Machine Learning, and Natural Language Processing are growing, makes this an ideal time for us to explore in depth which specific skills will our middle and top-level leaderships in the SCM sector will need to be competitive in the future. AI is no longer relegated to the realms of data scientists but is now fast becoming a basic skill which will differentiate between a successful and an unsuccessful supply chain. The call to action for the C-Suite is to assume centerstage and grab the opportunity.

Call for Action

DIGITAL ADOPTION READINESS

Organizations must understand the readiness level of individuals, departments, and their value chain to facilitate digital transformation. A lack of understanding and experience with digital technologies and tools can hinder new adoption. The research shows that the supply chain sector is not ready to provide seamless, end-to-end digital information highways for all modern supply chains to be more agile and resilient.

There is room for improvement in the sector's digital adoption readiness.

- Importance of organizational readiness: Even if individuals and departments are ready to adopt digitization, there is much that can be done at the enterprise level. The low percentage of organizations reporting readiness indicates room for improvement in organizational readiness for digital adoption.
- Small and medium-sized organizations face challenges: The supply chain sector involves small, medium, and large-sized organizations. Working across an organization's value chain may help small and medium-sized organizations face resource, capital, and knowledge constraints.
- Support mechanisms for small players: Upstream and downstream players may differ on current adoption levels, strategic objectives, and technology adoption priorities. The sector may consider mechanisms to assist small players in the industry or provide pathways for technology adoption to improve the overall sector's technological innovation.

BARRIERS TO DIGITAL ADOPTION

Organizational, Managerial, and Attitudinal (OMA) barriers are the most significant barriers to digital adoption readiness. Organizations should address these barriers by providing information on the benefits and ROI of digital technology, incentivizing managers, and employees to embrace the changes, and training them on the use of new technologies.

- Commitment to Upskilling: Organizations should provide employee upskilling programs to improve readiness for digital adoption. Organizations, Supply Chain Canada, and other professional associations should focus on the provision of training to ensure that employees are comfortable using new technologies, incentivize them to embrace the changes, and create a culture that values digital literacy.
- Commitment to Learning and Professional Development: Individuals should seek opportunities to upskill or reskill and demonstrate their ability to lifelong learning and professional development.
- Organizations, Supply Chain Canada, and educational institutions should focus on providing training and skill development opportunities geared toward advanced tools and technologies, which can be available for current employees and future graduates.
- Financial Market and Business Context: Organizations should know that financial and market conditions may slow digital technology adoption, especially for organizations at the early stages of the digital journey or with limited access to resources, knowledge, and finances.

- Legal/Privacy/Data Management: Organizations should focus on providing training specifically developed for the selected organization on data governance principles, which Supply Chain Canada, government agencies or other third parties can provide.
- Correlation between Availability to Implement New Digital Tools and Financial Market and Business Context Drive: Organizations, Supply Chain Canada and governments should work collaboratively to promote the ROI and benefits of technology implementation. Together, they can create pathways and appropriate support mechanisms during the technology implementation and training process.
- Internal Capital and Market Potential: Organizations must evaluate these factors before investing in expensive hardware, software, or consulting services necessary for successful technology adoption.
- Internal/External Collaboration: Organizations must collaborate with multiple stakeholders to leverage digital technologies' full potential.
- Regulatory Environment and Intellectual Property Protection: Policymakers can work closely with the sector to develop policies and regulations to support technology adoption while protecting intellectual property rights.
- Investment in Research and Development: Policymakers can support organizations by investing in infrastructure development and research and development.
- Digital Adoption Readiness Assessment Tools: All stakeholders (organizations, Supply Chain Canada, educational institutions and policymakers) can promote such tools and work to develop customized tools for specific industry sectors.

DIGITAL ADOPTION ENABLERS

Public/Private Funding and Financial Incentives to Adopt Innovative Technologies are essential enablers for organizations to implement projects related to emerging technologies. Technical Infrastructure, Digital Strategic Plan, Integration with Existing Systems, and Appropriate Consulting Services are all essential enablers for technology adoption projects.

- Awareness of Economic Benefits: There is a need to increase awareness of the economic benefits of past implementations and user cases. Governments and other bodies need to offer information and knowledge about different support programs offered by the government to enable information dissemination based on the industry sector, digital adoption journey, etc.

Canada's Digital Supply Chains





Since 1992, international trade has consistently contributed more than half of the value of Canada’s GDP, reaching a peak of more than 80% in 2000. As the COVID-19 supply chain shutdowns peaked in 2021, 61% of Canada’s GDP was still generated through trade. There was a 16.8% increase in the value of Canada’s overall merchandise exports in 2021, bringing the total to an all-time high of about \$1.24 trillion. The United States was Canada’s main trading partner in 2021, with a total trade volume of \$774 billion (\$476 billion exported and \$298 billion imported)⁷. The transportation supply chain is the backbone of this trade. Digitization of supply chains was one of the three major recommendations of the National Supply Chain Task Force⁸. End-to-end supply chain visibility, accountability, the efficiency of supply chains and security were some of the main benefits of digital supply chains as cited by the task force recommendations. The task force also recommended that the Government of Canada provide “small and medium-sized businesses with funding and incentives for automation to speed up adoption and enhance competitiveness”.⁹ Some of the other key recommendations of the report include:

- “Immediately undertake actions to “unstick” the transportation supply chain. These include addressing congestion at port container terminals and prioritizing government attention on regulations, policies and procedures that are impeding the effective operation of a reliable supply chain.”
- “Digitalize and create end-to-end transportation supply chain visibility for efficiency, accountability, planning, investment and security.”
- Establish a Supply Chain Office to unify the federal government’s responsibility/authority over transportation supply chain management across federal departments”
- “Develop, implement and regularly renew a long-term, future-proof (30- to 50-year) transportation supply chain strategy.”
- “Immediately address Canada’s significant transportation supply chain labour shortage.”

In October 2022, Canada’s federal Minister of Transport, The Hon’ble Omar Alghabra, announced a \$136 million Advancing Industry-Driven Digitalization of Canada’s Supply Chain initiative. The initiative aims “to develop digital solutions and optimize Canada’s supply chains”. This program, which would constitute a crucial aspect of Canada’s National Supply Chain Strategy, would increase both the efficiency and the resiliency of Canada’s supply chain by achieving the following goals:

- Making it easier to plan and coordinate transportation activities to alleviate bottlenecks, reduce congestion and be more resilient to disruptions by collecting and sharing data and analytics in real-time;

⁷ <https://tc.canada.ca/en/corporate-services/transparency/corporate-management-reporting/transportation-canada-annual-reports/2021/transportation-canada-2021>

⁸ <https://tc.canada.ca/en/corporate-services/supply-chain-task-force-glance>

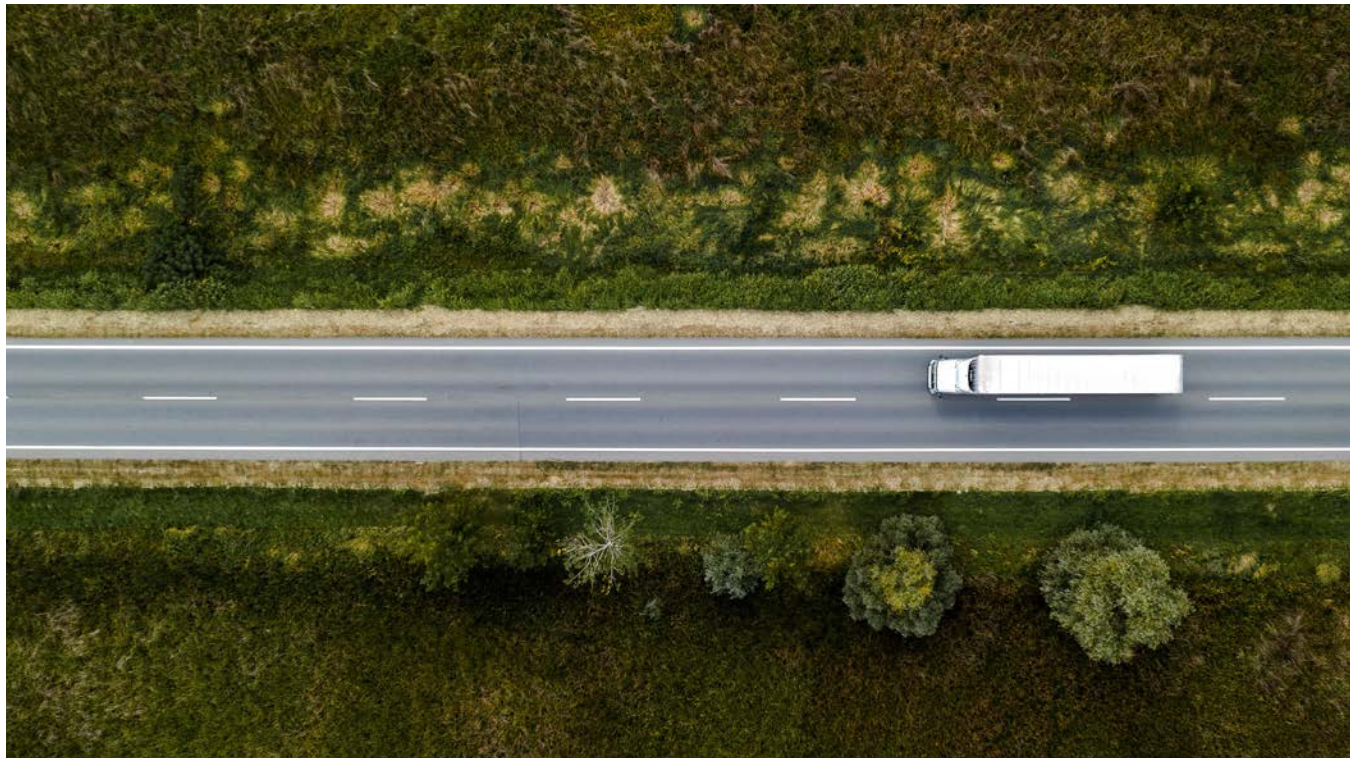
⁹ According to the September 2018 “Report from Canada’s Economic Strategy Tables: Seizing Opportunities for Growth” quoting a Brookfield Institute for Innovation & Entrepreneurship news release dated June 8, 2017, “Industries with the highest proportion of automatable work activities include: accommodation and food services; manufacturing; transportation and warehousing; agriculture, forestry, fishing and hunting; and mining, quarrying, and oil and gas extraction. About 62% of work activities could be automated within these industries.” Canada’s Economic Strategy Tables. September 25, 2018, p. 3. Available at: https://ised-isde.canada.ca/site/economic-strategy-tables/sites/default/files/attachments/ISED_SeizingOpportunities.pdf

- Supporting industry-driven approaches to digital solutions, especially in the areas of data collection, coordination, and improving the visibility of the transportation network for carriers, shippers and governments;
- Supporting evidence-based decision-making to further optimize existing networks and better plan infrastructure investments; and
- Working with industry to optimize trade corridors and gateways across Canada, such as the Pacific Gateway and the Windsor-Quebec trade corridor”.

The announcement points to the fact that digitization of supply chains is now being recognised as a solution to many of our supply chain risks, and disruptions and is being increasingly seen as a step towards designing resilient supply chains.

All of this takes us to the next logical question “what skills do we require to support a digital supply chain”?

Talent management capabilities must keep pace with the development of supply chain technologies and supply chain concepts. One way to do this is to utilize the growing gig economy to find new sources of talent. Having the proper people on your team is crucial, and in the future, experts in the supply chain will be expected to drive the organization’s strategy rather than just the supply chain plan. Research has shown four key personas that will play important roles in the supply chain of the future. Success in the future supply chain will require a team with a diverse set of skills and perspectives, rather than just one of each type of character. A recent report by EY¹⁰ presents four future personas for a digital supply chain of the future (Exhibit 4).



¹⁰ https://assets.ey.com/content/dam/ey-sites/ey-com/en_uk/topics/advisory/ey-supply-chain-skills-for-the-digital-era.pdf

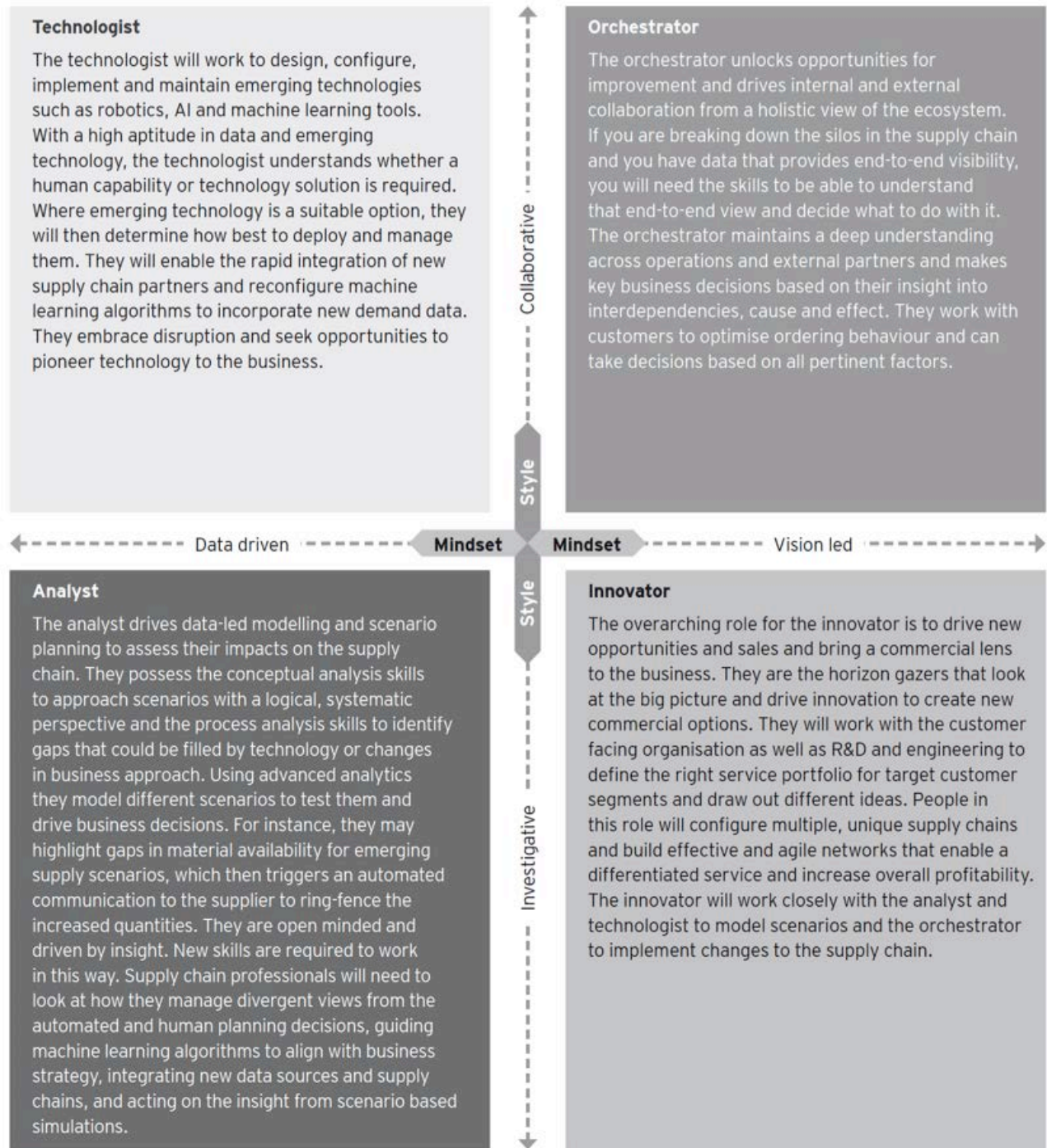


EXHIBIT 4: FOUR FUTURE PERSONAS FOR THE SUPPLY CHAIN

(Source : https://assets.ey.com/content/dam/ey-sites/ey-com/en_uk/topics/advisory/ey-supply-chain-skills-for-the-digital-era.pdf)

Workforce Skills in the New Era of Digital Supply Chains



The talent gap is a top constraint to growth. In the future of digital supply chains, there will be a growing need for professionals with diverse sets of skills to effectively manage and optimize supply chain operations. As digital technologies continue to evolve and disrupt traditional supply chain models, professionals will need to possess a combination of technical, analytical, and strategic skills.

- Procurement experts, for instance, will need to understand and apply the data from artificial intelligence systems to address business issues. They should also be good at managing money and forming partnerships within an ecosystem.
- Algorithms will assist factory managers in making decisions that maximize plant operations in the face of a deluge of data. Because there will be so much more data at their disposal, they will need to have strong analytical skills to make sound decisions.
- Artificial intelligence systems have a much greater ability to foresee and recognize patterns than people do. As a result, AI will handle the bulk of the planning, while humans will handle notifications and other tasks the computer cannot. Consequently, planners will have a greater grasp of the supply chain, allowing them to respond more rapidly and precisely to changes.

PEOPLE FIRST APPROACH TO DIGITIZATION:

Many businesses (across the transportation, energy, manufacturing, aviation, and EPC sectors) that we spoke to claim that they are making rapid strides toward becoming more digital. However, many seem to have forgotten that it is their responsibility to assist people in adjusting to the changes that are brought about by new technologies. Employees are not likely to accept new technologies if they are not provided with the appropriate training and support to work in the digital supply chain. This can result in the wasteful expenditure of money and discourages businesses from pursuing new business prospects. However, some businesses are succeeding, by putting an emphasis on people rather than technology.

The size, composition, and skillsets of the workforce will be particularly sensitive to the effects of digital disruption across the board. Roles will change, be redefined, and even disappear as more and more back-office tasks are automated. New technologies like machine learning (ML), cognitive planning (CP), demand signal interpretation (DSI), and robotics will require increasingly specialized personnel to implement effectively. This creates a difficult situation for company heads, who may need to retrain or acquire new skills and resources to maintain a competitive advantage.

“Digital transformation is not just about technology, it’s about people. Soft skills such as communication, collaboration, and adaptability are the real enablers of digital success, allowing individuals to navigate the constantly evolving digital landscape with ease.”

Doug Romanuk, Sr. Vice President

To train their staff, many top companies are investing in learning platforms - with or without third-party material and setting up learning ecosystems¹¹ to ensure learning is developed across departments. In this manner, employees can learn about the possibilities of new technologies, how they function, and the myriad ways in which they might be applied in the workplace. New methods of ideation, solution design, and implementation are also receiving investment from businesses. These encompass ideas from design thinking, customer journey mapping, and self-improvement.

¹¹ Fluor University <https://youtu.be/xlO9GY0aw-Q>



TECHNICAL SKILLS:

Technical skills are essential for understanding and analyzing data, automating and streamlining supply chain operations, cybersecurity, integration and interoperability and continuous learning. Professionals with strong technical skills will be able to manage and optimize supply chain operations by leveraging these technologies.

- **Understanding and Analyzing Data:** Digital technologies such as IoT, Artificial intelligence, and Blockchain generate large amounts of data. Professionals with technical skills will be able to understand and analyze this data and use it to optimize supply chain operations and make data-driven decisions.
- **Automation and Streamlining Supply Chain Operations:** Technical skills are also important for automating and streamlining supply chain operations. By understanding how to use digital technologies, professionals can automate repetitive tasks, reduce errors and increase efficiency. This includes using technologies like IoT sensors to monitor and control supply chain operations in real-time, using AI-based systems to predict demand, and using blockchain-based systems to improve supply chain transparency and traceability.
- **Cybersecurity:** With the increasing use of technology in supply chain management, cybersecurity has become a crucial skill to protect sensitive data and supply chain operations from cyber threats. Professionals with technical skills will be able to understand and implement cybersecurity best practices and understand how to protect their organization from cyber-attacks.
- **Integration and Interoperability:** Technical skills are also important for integrating and making different technologies and systems interoperable. This includes understanding how different systems and technologies work together, and how to integrate them to create a seamless and efficient digital supply chain.
- **Continuous Learning:** Digital technologies are constantly evolving, and professionals need to keep up with the latest developments and advancements. Technical skills include being able to learn and adapt quickly to new technologies, and continuously update their skills to stay relevant in the field.

DATA ANALYSIS AND VISUALIZATION:

With the increasing amount of data generated by digital technologies, the ability to collect, analyze, and interpret large amounts of data has become critical for making data-driven decisions. Professionals working in digital supply chains must be able to identify trends and patterns in supply chain operations and use this information to make informed decisions. They should also have the ability to create data visualizations to communicate findings and insights to stakeholders.

- **Data-Driven Decision-Making:** Digital supply chains generate vast amounts of data, including data on customer demand, supplier performance, logistics, and inventory. Data analysis and visualization skills allow professionals to make sense of this data and use it to make data-driven decisions. This includes identifying trends and patterns in data and using this information to optimize supply chain operations and improve performance.
- **Predictive Analytics:** Data analysis and visualization skills also allow professionals to use predictive analytics to forecast future demand, identify potential supply chain disruptions, and optimize logistics and inventory. By analyzing historical data and identifying patterns, professionals can make predictions about future performance and take proactive measures to address potential issues.
- **Supply Chain Performance Metrics:** Data analysis and visualization skills are also important for measuring and evaluating supply chain performance. By analyzing data on key performance indicators (KPIs), such as delivery times, inventory levels, and supplier performance, professionals can identify areas for improvement and develop plans to optimize supply chain operations.

- **Communication:** Data analysis and visualization skills are also essential for effectively communicating data and insights to stakeholders. Professionals with data visualization skills can create clear and compelling visualizations that communicate findings and insights in an easy-to-understand format.
- **Continuously Improving:** The ability to analyze and visualize data is not a one-time task, but a continuous effort that requires professionals to be able to update and improve their analysis as new data is generated.

NETWORK AND COLLABORATION:

Digital supply chains rely on collaboration and communication between different stakeholders, so skills related to networking and relationship building are essential. Professionals working in digital supply chains must be able to effectively communicate with internal and external stakeholders, including suppliers, customers, and partners. They must also be able to build and maintain strong relationships with these stakeholders to drive collaboration and innovation.

- **Communication:** Networking and collaboration skills are essential for effective communication between different stakeholders in the digital supply chain. This includes the ability to communicate with internal and external stakeholders, such as suppliers, customers, and partners, and to understand their needs and requirements.
- **Relationship Building:** By building trust and understanding with stakeholders, professionals can drive collaboration and innovation, and work together to optimize supply chain operations.
- **Coordination:** This includes coordinating the flow of goods and information between suppliers, customers, and partners, and managing the logistics and transportation of goods.

- **Problem-Solving:** This includes the ability to work with stakeholders to identify problems and develop solutions, as well as the ability to mediate conflicts and resolve disputes.
- **Collaborative Innovation:** Networking and collaboration are important for fostering a culture of innovation and continuous improvement within a digital supply chain. By working closely with stakeholders and partners, professionals can identify new opportunities and develop new processes and technologies that can drive supply chain performance.

ADAPTABILITY AND FLEXIBILITY:

The digital supply chain is constantly evolving and changing, so professionals must be able to adapt to new technologies and processes quickly. They must also be able to work in a fast-paced environment and be comfortable with ambiguity and uncertainty. This requires a willingness to take risks, think creatively, and continuously learn and grow.

In the digital supply chain, adaptability and flexibility are key to success. With new technologies and digital processes emerging all the time, professionals must be able to adapt to change and take advantage of new opportunities.

STRATEGIC THINKING:

Strategic thinking is a critical skill that will be essential for professionals working in digital supply chains of the future. It allows professionals to identify new opportunities, align digital supply chain initiatives with organizational goals, manage risk and uncertainty, build, and manage digital supply chain ecosystems and continuously improve digital supply chain performance.

- **Identifying and Capitalizing on New Opportunities:** Strategic thinking allows professionals to identify new business opportunities that arise from digital supply chain transformations. This includes identifying new markets, products, and services, as well as new ways of working and collaborating with partners and suppliers. By thinking strategically, professionals can help organizations take advantage of new opportunities and stay ahead of the competition.
- **Aligning Digital Supply Chain Initiatives with Organizational Goals:** Strategic thinking is also essential for aligning digital supply chain initiatives with organizational goals. This includes understanding the organization's overall strategy and objectives and ensuring that digital supply chain initiatives are aligned with them. It also includes making decisions about which technologies and processes to implement, and how to optimize digital supply chain operations to support the organization's goals.



- **Managing Risk and Uncertainty:** Strategic thinking is also important for managing risk and uncertainty in digital supply chains. As digital supply chains become more connected, the risk of cyber-attacks, supply chain disruptions, and other threats increases. By thinking strategically, professionals can identify potential risks and develop plans to mitigate them.
- **Building and Managing Digital Supply Chain Ecosystems:** Strategic thinking is also essential for building and managing digital supply chain ecosystems. This includes understanding the role of different stakeholders and partners in the ecosystem, and how to effectively collaborate and communicate with them. It also includes understanding the different technologies and processes that are used in the ecosystem and how to optimize them to support the organization's goals.
- **Continuously Improving Digital Supply Chain Performance:** Strategic thinking is also important for continuously improving digital supply chain performance. By thinking strategically, professionals can identify areas for improvement and develop plans to optimize digital supply chain operations. This includes understanding the different metrics used to measure digital supply chain performance and using them to make data-driven decisions.

Currently, employees lack the authority to act with agility. If supply chain leaders truly want to establish an agile workforce, they must restructure work and prioritize digital-supporting capabilities. Ensure that workflows (processes, tools) provide beneficial work results while rethinking work. The focus must be on simplification and removal. Start by eliminating specific procedures, partners, rules, and policies that employees must adhere to complete workflows or accomplish particular work outputs. Next, consolidate systems, giving priority to innovative solutions that lessen the requirement for technical skills among supply chain personnel. Then, remove less necessary competency criteria from supply chain roles when new, critical abilities are added to guarantee that talent is concentrating on demonstrating and growing the appropriate skills. Adapting to new technology and exploiting data and analytics efficiently in the supply chain will demand new skills. For employees to work digitally and support the efforts of becoming a digital enterprise, supply chain positions will require digital dexterity skills. And as the supply chain places a greater emphasis on data and analytics, the average employee will need to gain data literacy abilities.

The attitudes, mindsets, and behaviours that drive digital business transformation make up what we refer to as digital dexterity. It is possible to express it using two different dimensions, the employees:

- (1) ambition and capacity to establish digital firms, and
- (2) ambition and ability to operate digitally

Adoption of Digitization in Supply Chain

The current situation in the world of business places an ever-increasing premium on the implementation of digital technology in the industrial sector. During the last ten years, manufacturing companies have been investigating how emerging digital technologies, such as the Internet of Things (IoT), big data analytics (BDA), and artificial intelligence (AI), can be implemented into their production and supply chain management systems (SCM). It is believed that these technologies will prove to be effective ways to enhance several operations of supply chains, including logistics, scheduling, and inventory management.

The Internet of Things has seen widespread application in manufacturing facilities, as well as in transportation, to track and trace logistics and warehouse operations, as well as monitor the production process. When integrated with data from other supply chain activities, the real-time data acquired from IoT devices have the potential to provide significant commercial value through the application of both BDA and AI. It could assist businesses in improving their ability to estimate client requests, reveal inventory problems, optimizing resource allocation, and manage relationships with suppliers. These newly developed digital technologies are not only influencing product and process modifications, but also value chains, business model renovations, and industrial structure alterations.

However, there is no guarantee that the implementation of digital technology would be successful. A significant number of manufacturing companies made substantial expenditures in digital transformation, yet many were unable to provide the anticipated business value¹². The divergence between the process of formulating the strategy and carrying it out is frequently the root reason for failed attempts¹³. Inefficiently adopting digital technology could result in disruptive change, which would then lead to a significant increase in risk and uncertainty during the transformation. Researchers have suggested that the structure of supply chains might shift from a paradigm of centralized production to one of distributed production as a result of the rise of digital manufacturing. This typically results in a significant shortening of the supply chain, which results in the potential hazards to other participants within the supply chain as a result of the fact that they,

too, need to quickly adjust to this disruptive change¹⁴. The technological, organizational, and environmental elements all have a considerable impact on the rate of adoption of digital technology. Therefore, before implementing any technologies, businesses need to understand the aims of the technology, evaluate these variables, assess what could happen during the process, and analyze how each activity could potentially affect the supply chain. In other words, businesses need to begin by analyzing “why” (which represents the drivers, purposes, and motives), then “how” (which represents the processes or procedures), and then “what” (which represents the impacts, outputs, or results). The current understanding of these three layers (i.e., why adopt digital technologies in the supply chain, how to adopt digital technologies, and what digital technologies to adopt) of adopting digital technologies in the supply chain is still limited. This is despite the growing research interests in the area. When it comes to aligning their implementation procedures with their drivers to achieve the intended outcomes of adopting digital technology, managers continue to struggle with the obstacles that this alignment presents.

ENABLERS FOR THE ADOPTION OF DIGITIZATION

The digitization of supply chains is becoming increasingly important as companies look to stay competitive in an ever-evolving business landscape.

TECHNOLOGICAL ADVANCEMENTS:

The development of new technologies such as IoT, blockchain, and AI has made it possible for companies to digitize their supply chains and improve efficiency and transparency. IoT devices, for example, can be used to track and monitor the movement of goods through the supply chain, providing real-time visibility of inventory levels and enabling companies to respond quickly to changes in demand. Blockchain, on the other hand, can be used to create a tamper-proof record of transactions, improving transparency and reducing the risk of fraud.

¹² Correani, A., De Massis, A., Frattini, F., Petruzzelli, A. M., & Natalicchio, A. (2020). Implementing a Digital Strategy: Learning from the Experience of Three Digital Transformation Projects. *California Management Review*, 62(4), 37–56. <https://doi.org/10.1177/0008125620934864>

¹³ Raj, Arun. “Editorial preface: Developing sense-and-respond capabilities for the digital economy.” *Information Resources Management Journal* 13.4 (2000): 3.

¹⁴ Holmström, Jan, and Jouni Partanen. “Digital manufacturing-driven transformations of service supply chains for complex products.” *Supply Chain Management: An International Journal* (2014).

COST SAVINGS:

Digitization can lead to significant cost savings through the automation of processes and the reduction of errors. Automation of manual processes, such as data entry and order tracking, can reduce the number of errors that occur and increase efficiency. This can also lead to reduced labour costs, as fewer employees are needed to perform these tasks. Additionally, digitization can also lead to reduced costs associated with inventory management, as companies can more accurately track their inventory levels and reduce the risk of overstocking or stockouts.

IMPROVED VISIBILITY:

Digitization allows companies to have real-time visibility of their supply chain, allowing them to make data-driven decisions and respond quickly to changes in demand. This can be achieved using sensors, RFID tags, and other IoT devices that can track the movement of goods through the supply chain. This real-time visibility can also help companies to accurately forecast demand and plan accordingly.

INCREASED EFFICIENCY:

Digitization can lead to faster and more accurate processing of data, resulting in improved efficiency across the supply chain. For example, the use of blockchain technology can reduce the time it takes to process transactions, as all parties can access the same data in real time. This can also lead to reduced lead times, as companies can more quickly respond to changes in demand.

BETTER CUSTOMER SERVICE:

Digitization allows companies to provide better customer service by giving them access to real-time data on the status of orders and shipments. This can help companies to more quickly resolve issues and provide more accurate tracking information to customers. Additionally, digitization can also enable companies to identify and respond to customer needs and preferences, resulting in improved customer satisfaction more easily.

BARRIERS TO THE ADOPTION OF DIGITIZATION

There are several barriers to the adoption of digitization in supply chains. The adoption of digitization in supply chains is hindered by a range of factors. To overcome these barriers, companies need to invest in educating their workforce, developing standardization, and investing in security and infrastructure development. Some of the most significant include:

LACK OF UNDERSTANDING:

Many companies and individuals in the supply chain industry are not familiar with the technology and its capabilities. This can make it difficult to identify the potential benefits and make informed decisions about implementation.

COST:

Implementing digital technology can be expensive, especially for smaller companies. The costs of hardware, software, and training can be prohibitive for some organizations.

LACK OF STANDARDIZATION:

There is currently no standardization in the supply chain industry when it comes to digital technology. This can make it difficult for companies to integrate different systems and can lead to increased costs.

DATA SECURITY:

Supply chain companies handle a lot of sensitive data, such as financial information and the personal information of customers. Ensuring the security of this data is a major concern for many organizations and can be a barrier to adoption.

RESISTANCE TO CHANGE:

Change can be difficult for many people, and this is especially true in the supply chain industry. Many employees have been doing things a certain way for a long time and may be resistant to new technology and new ways of working.



LIMITED RESOURCES

Many small and mid-sized companies in the supply chain industry have limited resources and may not have the personnel or financial resources to invest in new technology.

COMPLEXITY:

Digitization in the supply chain is complex and requires a significant amount of planning and coordination across different departments and organizations. This can be difficult to achieve and can slow down the adoption process.

LACK OF INTEROPERABILITY:

Different systems used in the supply chain are often not able to communicate with one another, making it difficult to share information and track goods as they move through the supply chain.

LEGACY SYSTEMS:

Many companies in the supply chain industry still rely on legacy systems that are not able to integrate with newer digital technology. This can make it difficult for these companies to adopt digitization.

INADEQUATE INFRASTRUCTURE:

In many developing countries, inadequate infrastructure can be a major barrier to digitization in the supply chain. This includes a lack of reliable internet access, lack of access to electricity, and limited access to technology.

“Digital technologies play a critical role in modern day supply chains. Automation, data analytics, and AI have the potential to streamline logistics processes, reduce costs, and enhance supplier relationships. However, the top barrier to adoption is data privacy and cyber security.”

James Auld, Director of Strategy, CN Rail

New Roles in Digital Supply Chains

```
static function day_List() {
    $result = mysql::query("SELECT * FROM image_date ORDER BY shot_date DESC");

    while($day = mysql::fetch($result)) {
        $studio_list = array();
        $shots_result = mysql::query("SELECT DISTINCT(studio) as studio, COUNT(*) as count FROM image WHERE day_id = " . $day->day_id);
        while($studio_list = mysql::fetch($shots_result)) {
            $day_info = metadata::day_info($day->shot_date, $studio_list->studio, "quick");
            $temp_studio_list[] = array("studio" => $studio_list->studio, "count" => $studio_list->count, "title" => $studio_list->title);
        }
        $day->studio_list = $temp_studio_list;
        $return[$day->shot_date] = $day;
    }

    return $return;
}

static function day_info($date, $studio) {
    global $global_studio_list;
    if(!in_array($studio, $global_studio_list)) die("error studio");
    $date = mysql::escape($date);
    if(mysql::count("image_date", "shot_date = '$date'") != 1) die('date not found');
    $studio = intval($studio);

    $return = array();

    $result = mysql::query("SELECT image.id as image_id FROM image, image_date WHERE image_date.id=image.day_id AND image_date.shot_date = '$date'");
    while($image = mysql::fetch($result)) {
        $image->copyright = metadata::get_copyright($image->image_id);
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Using the capabilities that artificial intelligence provides, businesses are reducing the complexity of their supply chains and increasing their responsiveness. Companies are improving their knowledge-intensive operations, such as supply chain planning, client order management, and inventory tracking, with the use of artificial intelligence (AI), machine learning (ML), robotics, and advanced analytics. Walmart employs AI algorithms to improve the efficiency of its supply chain. The firm has built a system called Eden that is powered by AI and helps forecast the demand that customers will have for items. It also guarantees that inventory levels are maintained to satisfy the demand that is predicted. Additionally, to improve the efficiency of its logistics network and cut down on the expenses of transportation, Walmart has adopted machine learning algorithms. Similarly, Amazon has been employing artificial intelligence (AI) for many years to better its supply chain. The firm utilises machine learning algorithms to forecast the demand for its items and to optimise its warehouse operations to speed up the delivery of such products to the company's consumers. Another example of such deployment of AI can be seen in Coca-Cola. The firm has deployed a system driven by an artificial intelligence known as the Dynamic Scheduling System. This system makes use of machine learning algorithms to maximise the efficiency of the company's product manufacturing and distribution. The system takes into account a broad variety of parameters, including things like transportation costs, manufacturing capacity, and inventory levels, in order to ensure that items are delivered to clients on time and at the most cost-effective price feasible. Closer to the world of logistics, AI has been put to use at the world's largest container shipping firm, Maersk. "TradeLens" is the name of the AI-powered system that the firm has created. TradeLens uses machine learning algorithms to improve the flow of commodities throughout their global supply chain. To guarantee that items are delivered to clients in the most timely and cost-effective manner possible, the system takes into consideration a broad variety of criteria, including shipping routes, customs restrictions, and port congestion, among many others.

It does not mean that humans will be rendered obsolete as labourers. In fact, Paul Daugherty and H. James Wilson have written a new book titled "Human+Machine: Reimagining Work in the Age of AI"¹⁵ that dispels the common myth that artificial intelligence systems would eventually replace humans in all areas of business. The fundamental strength of artificial intelligence lies in its ability to complement human capacities; while it will be used to manage specific jobs, including decision-making at a higher level, this technology's ultimate potential will not be realized until it is applied to the supply chain. Both human beings and machines are necessary components of this new environment: The potential of humans and robots working together in jobs such as supply chain planning and inventory management will produce new sources of value for enterprises.

AI, when coupled with advanced analytics, will empower supply chain planners to make decisions with a greater focus on the long-term strategy of their operations and reduce the amount of time they spend on reactive problem solutions. These planners will take the lead in the transition from an outdated operating model for supply chains, which is characterized by a lack of flexibility and a slow pace, to a new dynamic model that features genuine end-to-end segmentation. This necessitates the management of both commercial relationships and exceptions, in addition to the development of different supply chains that are tailored to the requirements of specific client micro-segments. Concurrently, a new role for digital engineers is likely to come into existence. This person will be a highly analytical data scientist who is also proficient in digital technology. They will be responsible for managing, modelling, and modifying the algorithms, alert protocols, and parameters that direct automated decision-making planning systems. The rising demand for human workers who possess the skill set of digital engineers will cause the importance of having strong analytical skills to increase.

The most successful businesses are aware that this shift is on the horizon and have already begun to adapt their supply chain workforces. Research conducted by Accenture Strategy found that 90% of executives believe that the current workforce would become proficient in digital

¹⁵ <https://store.hbr.org/product/human-machine-reimagining-work-in-the-age-of-ai/10163>

technologies such as augmented reality, 3D printing, and automation over the next five years. In addition, ninety-two percent of CEOs who were surveyed claimed that supply chain workforces will be upskilled and enabled to engage and operate smoothly with machines.

In other words, workers in the supply chain are already beginning to adjust to working efficiently with a variety of intelligent technologies, such as robots, cobots, and virtual agents, in order to complete the tasks that will be required of them in the future. These technologies can, for instance, assist reinforce the right procedures on the work floor, monitoring how staff execute jobs and advising them to do so in the most effective way possible. Through the use of AI, Thyssenkrupp can overcome talent mismatches. An augmented reality device made by Microsoft called HoloLens is provided to the elevator technicians employed by the industrial services company so that they can confer with subject-matter experts.

Leaders in the supply chain have a responsibility to prepare their teams for the change that is inevitably coming and is now underway. That includes committing to reskilling individuals and moving them to other parts of the company where they can provide more value and where they will be more productive. A significant consumer goods company implemented machine learning as an adjunct to more conventional methods of forecasting. This led to an improvement in the accuracy of forecasts and the management of inventories, as well as the elimination of the need for manual reviews and calculations, which had previously consumed almost 80 percent of the available time. As a consequence of this, the corporation redirected the efforts of its human workers to give insightful market intelligence.

The following is a list of other methods in which leaders of supply chains can maintain this momentum and enable human workers to collaborate with AI most effectively :

- **Encourage the next generation of workers.** It is time to find unique talent by exploring outside of the supply chain at this point. Data scientists, risk managers, and business development leads are

examples of the kinds of personnel who have the potential to contribute significantly to the supply chain's bottom line. Companies should also make sure that their workplaces reflect the ethos of the new supply chain by integrating mobility, technology, and collaboration tools and by reinforcing new behaviours and mindsets throughout the talent development life cycle. This should be done to ensure that their workplaces are in line with the new supply chain. When it comes to recruitment, performance measures, and career advancement, you need to approach everything through the prism of innovation that is driven by technology.

- **Separate the human and the Robot.** Determine which opportunities may be realized immediately and which can be realized in the medium term and prioritize them according to the individual roles and responsibilities involved. Artificial intelligence (AI) systems will only continue to advance and become more intelligent in their ability to make decisions. As a consequence of this, it is necessary to reorient and retrain human workers so that they may concentrate on high-value endeavours such as improving the customer experience and innovating new products.
- **Put your money where your innovation is.** Think big but start small by mapping opportunities to integrate AI with already existing technology solutions. Think big but start small. Up until this point, technology such as robotics, big data, analytics, and others have been employed in conjunction with people but independently of one another. Increasing the effectiveness of the process is their responsibility. All of that has changed, however, with the introduction of AI systems that can feel, communicate, interpret, and learn. AI has the potential to assist organizations in moving beyond automation and elevating human capabilities, both of which generate new value for the company.

¹⁶ <https://hbr.org/2018/08/new-supply-chain-jobs-are-emerging-as-ai-takes-hold>

As supply chain management continues to evolve and adapt to new technologies and business models, new roles will be created to address the changing needs of companies. Some of the roles that may be created in the future include:

SUPPLY CHAIN ANALYTICS MANAGER:

With the increasing amount of data available in the supply chain, companies will need individuals with the skills to analyze and interpret this data to make informed decisions. Supply Chain Analytics Managers will be responsible for collecting and analyzing data from various sources, such as ERP systems, sensor data, and social media, to identify patterns and trends that can improve supply chain performance.

DIGITAL SUPPLY CHAIN MANAGER:

As more companies adopt digital technologies to manage their supply chains, roles dedicated to managing these technologies will become more prevalent. Digital Supply Chain Managers will be responsible for implementing and managing digital solutions, such as automation and artificial intelligence, to improve supply chain efficiency and visibility.

SUSTAINABILITY AND RESPONSIBLE SOURCING MANAGER:

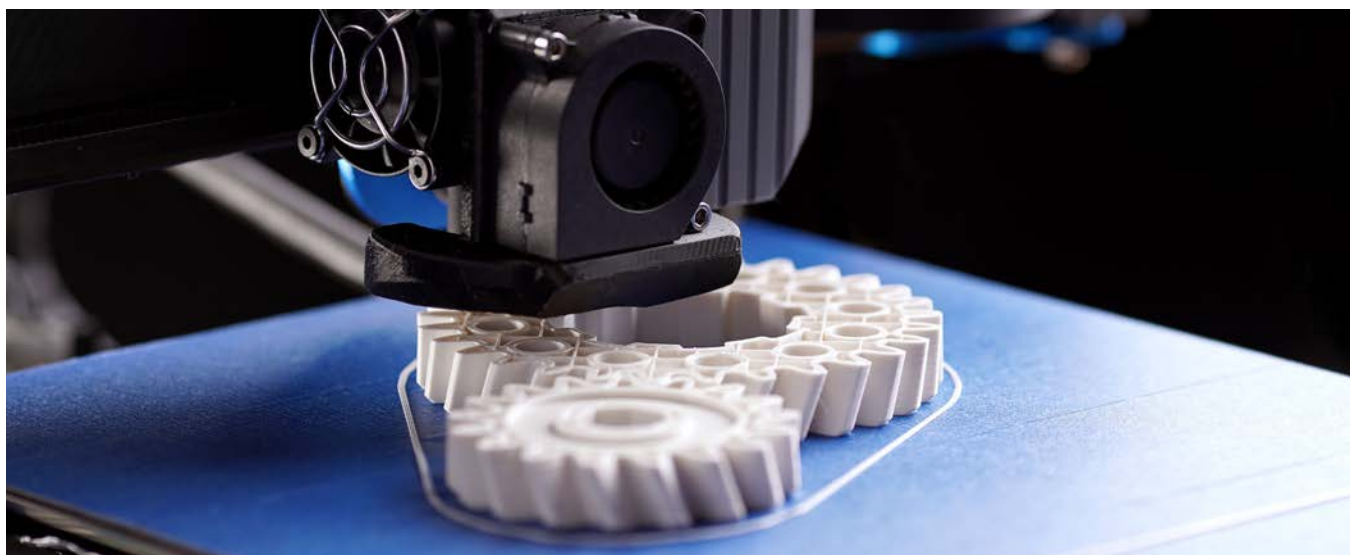
As more companies prioritize sustainability and responsible sourcing, roles focused on these areas will become more important. Sustainability and Responsible Sourcing Managers will be responsible for implementing sustainable practices and ensuring that suppliers meet the company's standards for responsible sourcing.

BLOCKCHAIN COORDINATOR:

Blockchain technology has the potential to revolutionize supply chain management by improving transparency and traceability. Blockchain Coordinators will be responsible for implementing blockchain solutions in the supply chain and ensuring that all stakeholders, including suppliers and customers, can access and utilize the information stored on the blockchain.

3D PRINTING COORDINATOR:

With the increasing adoption of 3D printing in manufacturing, roles focused on managing the integration of this technology into the supply chain will become more important. 3D Printing Coordinators will be responsible for managing the design, production, and delivery of 3D printed parts and products.



SUPPLY CHAIN CYBERSECURITY MANAGER:

As supply chains become increasingly digital, cybersecurity will become a more important concern. Supply Chain Cybersecurity Managers will be responsible for identifying and mitigating cyber risks and ensuring that the supply chain is protected from cyber-attacks.

SUPPLY CHAIN RESILIENCE MANAGER:

As supply chains become more complex and global, the ability to respond to disruptions will become increasingly important. Supply Chain Resilience Managers will be responsible for developing and implementing strategies to ensure that the supply chain can respond quickly and effectively to disruptions, such as natural disasters or pandemics.

SUPPLY CHAIN NETWORK OPTIMIZATION MANAGER:

As companies look to optimize their supply chains and reduce costs, roles focused on network optimization will become more important. Supply Chain Network Optimization Managers will be responsible for analyzing and optimizing the supply chain network to identify opportunities for cost savings and efficiency improvements.

ADVANCED PLANNING AND SCHEDULING MANAGER:

As companies look to improve demand forecasting and production planning, roles focused on advanced planning and scheduling will become more important. Advanced Planning and Scheduling Managers will be responsible for using advanced techniques, such as machine learning, to improve demand forecasting and production planning.

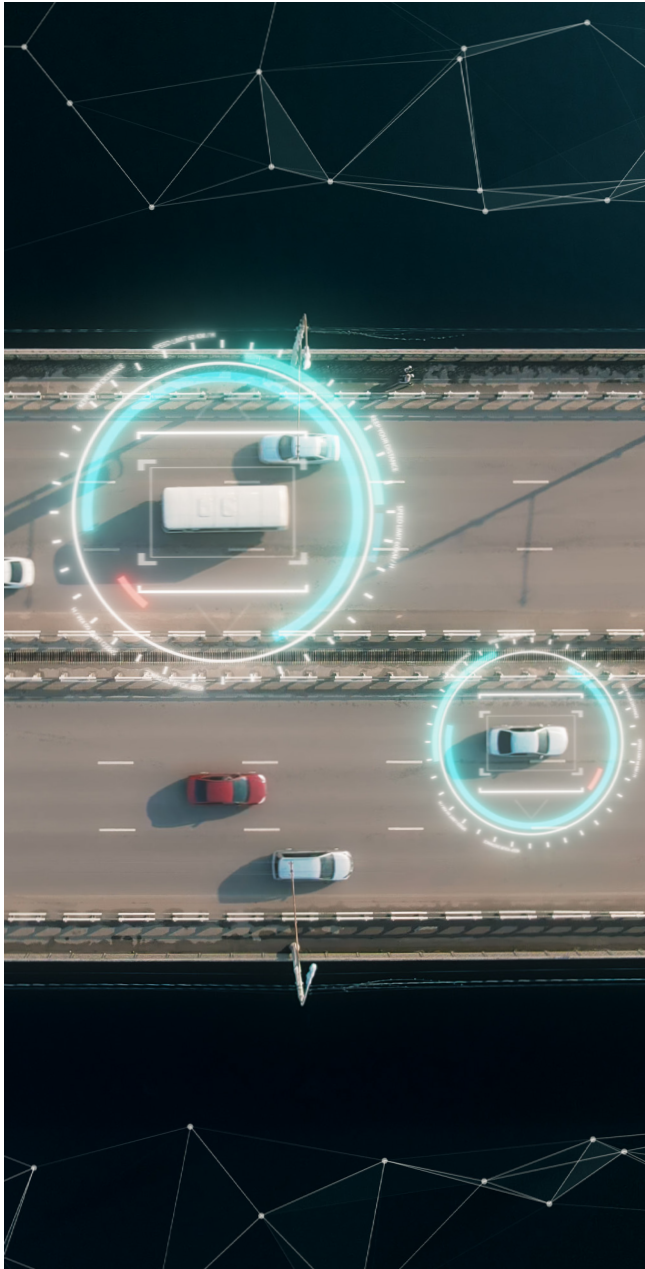
SUPPLY CHAIN TALENT DEVELOPMENT MANAGER:

As the supply chain industry continues to evolve and new roles are created, companies will need to focus on developing the talent needed to fill these roles. Supply Chain Talent Development Managers will be responsible for identifying the skills and training needed for new roles and developing programs to help employees acquire these skills.

SUPPLY CHAIN COMMUNICATION EXPERT

The importance and vulnerability of global supply networks are increasingly acknowledged by business leaders, financiers, and even politicians. Supply chain information professionals will be in high demand as a result of the increased need for more complete supply chain representations.

In today's fast-paced business environment, supply chain communicators must distill the complexities of global supply chains into clear, actionable messages. Of course, they'll require an extensive understanding of the subject matter, but they'll also need to be able to see each supply chain problem from the eyes of many stakeholders. What information is crucial for the CEO to have on the material flow of the company? Supply chain generalists may fill this function at smaller businesses. When it comes to managing, visualizing, and explaining intricate global supply chains, however, team members at big and multinational organizations may devote a disproportionate amount of effort to building key performance indicators, dashboards, and other innovative tools.



TRACEABILITY EXPERT

Companies' lack of control over their supply networks is open knowledge. For a long time, all businesses needed to do was know their immediate superiors and their immediate subordinates, or their suppliers and their customers. The fact that most businesses are unaware of their suppliers' subcontractors increases the likelihood of adverse events. COVID-19 exposed this open secret of the industry. Forty percent of the Fortune 500 companies of the world had supply chains that ended up in a single province of China.

To a large extent, that mentality is to blame for the worldwide interruptions that most businesses are facing right now. Those who do not have complete insight and awareness into their supply chain may not be aware of an impending deficiency at the farthest reaches. Consider the far-reaching effects of the recent worldwide semiconductor shortages, which have hit even the biggest automakers hard.

The growing interest in tracking down sources might provide the solution. The pharmaceutical industry was an early adopter of traceability because of the need for meticulous monitoring of potentially dangerous chemicals and other pharmaceutical items. Companies depending on a growing array of technical tools and people to track their supply chains from raw material acquisition to final customer fulfillment are spreading the practice to the food production industry as well.

Analysts and specialists in the field of traceability will soon be in high demand, and they will require many of the same fundamental abilities as other supply chain professionals. They'll require strong interpersonal skills since they'll be responsible for gathering data from several sources and using that data to serve a wide variety of internal and external partners and clients in real-time.

These roles in supply chain management are based on current trends and predictions of future developments. However, it's important to note that the field of supply chain management is constantly changing and evolving, and new roles may emerge as the industry continues to evolve and adapt to new technologies and business models.

Supply Chain Roles that may Disappear



Any job or role that requires repetitive work, with low levels of innovation, is most susceptible to being replaced.

MANUAL DATA ENTRY POSITIONS:

With the increasing use of automation and artificial intelligence, tasks such as data entry will likely be completed by machines, rather than by human workers. This could lead to a reduction in the number of manual data entry positions within the supply chain. Automation of data entry can help to reduce errors, increase efficiency, and free up human workers to focus on more complex and valuable tasks. For example, using optical character recognition (OCR) technology to automatically capture and process data from invoices, purchase orders, and other documents can save time and reduce the risk of errors. Additionally, using machine learning algorithms to automatically classify and categorize data can improve the accuracy and speed of data analysis.

LOGISTICS COORDINATION ROLES:

With the use of advanced logistics software and tracking systems, it may become possible for machines to coordinate the movement of goods more efficiently than human workers. This could lead to a reduction in the number of logistics coordination roles within the supply chain. Automation of logistics coordination can help to improve efficiency, reduce costs, and increase transparency in the supply chain. For example, using transportation management systems (TMS) to plan and optimize routes, schedule deliveries, and track shipments in real time can

improve the efficiency and cost-effectiveness of logistics operations. Additionally, using advanced analytics and machine learning algorithms to predict demand, identify bottlenecks, and optimize inventory levels can improve the responsiveness and agility of the supply chain.

RETAIL STORE MANAGERS:

As e-commerce continues to grow in popularity, roles such as retail store managers may become less necessary. With more customers shopping online, there may be less need for human workers to manage physical retail locations. This could lead to a reduction in the number of retail store manager roles within the supply chain. However, e-commerce and digital marketing skills may become more valuable as the shift toward online sales continues. For example, using digital platforms and marketplaces to reach new customers, personalize the shopping experience, and optimize pricing and promotions can help to drive online sales and improve customer loyalty. Additionally, using data analytics and machine learning algorithms to track customer behaviour, preferences, and feedback can help to improve the effectiveness of marketing campaigns and product development.

INVENTORY MANAGEMENT ROLES:

Inventory management roles that rely heavily on manual processes may become less necessary in the future. With the use of advanced inventory management software and automation, it may become possible for machines to manage inventory more efficiently than human workers. This could lead to a reduction in the number of inventory management roles within the supply chain. Automation of inventory management can help to improve efficiency, reduce costs, and increase transparency in the supply chain. For example, using warehouse management systems (WMS) to automate the tracking, storage, and movement of inventory can help to improve the accuracy, speed, and security of inventory operations. Additionally, using advanced analytics and machine learning algorithms to predict demand, optimize stock levels, and identify patterns and trends can help to improve the responsiveness and agility of the supply chain.

TRANSPORTATION PLANNING POSITIONS:

With the use of advanced transportation planning software and automation, it may become possible for machines to plan transportation routes and schedules more efficiently than human workers. This could lead to a reduction in the number of transportation planning positions within the supply chain. Automation of transportation planning can help to improve efficiency, reduce costs, and increase transparency in the supply chain. For example, using transportation management systems (TMS) to plan and optimize routes, schedule deliveries, and track shipments in real time can help to improve the efficiency and cost-effectiveness of transportation operations.

WAREHOUSING AND DISTRIBUTION ROLES:

Warehousing and distribution roles that involve mainly manual labour may become less necessary in the future. With the use of advanced warehouse management software and automation, it may become possible for machines to manage warehouses and distribute goods more efficiently than human workers. This could lead to a reduction in the number of warehousing and distribution roles within the supply chain. Automation of warehouse and distribution management can help to improve efficiency, reduce costs, and increase transparency in the supply chain. For instance, using warehouse automation technology like automated storage and retrieval systems (ASRS) can help to automate the handling of inventory, increasing the speed and accuracy of inventory tracking, and reducing the need for manual labour.

Critical Insights

DIGITAL ADOPTION READINESS:

- Understanding the readiness level: organizations must understand the readiness level of individuals, departments, organizations, and sectors to facilitate digital transformation. A lack of understanding and experience with digital technologies and tools can hinder new adoption.
- Importance of organizational readiness: Even if individuals and departments are ready to adopt digitization, there is much that can be done at the enterprise level. The low percentage of organizations reporting readiness at level 5 indicates room for improvement in organizational readiness for digital adoption.
- Small and medium-sized organizations face challenges: The supply chain sector involves small, medium, and large-sized organizations, and small and medium-sized organizations may face resource, capital, and knowledge constraints.
- Support mechanisms for small players: There must be support mechanisms to assist small players in the industry or provide pathways for technology adoption to improve the overall sector's technological innovation.
- Lack of correlation between sectors and individual readiness: The moderate positive correlation between the individual and the department but no significant correlation between the individual, organization, department, and sector suggests that strategic directions and objectives may influence technology readiness at the organizational level and supply chains are complex networks where upstream and downstream players may differ on current adoption levels, strategic objectives, and technology adoption priorities.
 - Room for improvement: The fact that no participant reported readiness at level 5 at the sector level is a serious and damning indictment of how the supply chain sector is not ready to provide seamless, end-to-end digital information highways for all modern supply chains to be more agile and resilient. There is room for improvement in the sector's digital adoption readiness.

BARRIERS TO DIGITAL ADOPTION:

- Organizational, Managerial, and Attitudinal (OMA) barriers are the most significant barriers to digital adoption readiness, with approximately 72% of participants rating it as a barrier three or above. Organizations should address these barriers by providing support and training to organizations to improve their organizational and attitudinal readiness for digital adoption. Also, providing information on the benefits and ROI of digital technology, incentivizing managers, and employees to embrace the changes, and training them on the use of new technologies.

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- Individual Commitment of the Employee to New Technologies is also an essential factor for successful digital adoption. Although it was not identified as a critical barrier, approximately 50% of participants responded by selecting it below level 3. Organizations should focus on adequately training employees to ensure they are comfortable using new technologies, incentivize them to embrace the changes, and creating a culture that values digital literacy
 - Institutional/Governmental Support to Implement New Technologies was rated below level three by approximately 65% of participants, with approximately 36% indicating it is not a barrier to digital adoption. Organizations should provide institutional and government support through training, funding, and employee upskilling programs to improve organizations' readiness for digital adoption.
 - Financial Market and Business Context Drive the Implementation of Newer Technologies at Work is another factor that affects digital adoption. Approximately 57% of respondents rated it as three or above. Organizations should know that financial and market conditions may slow digital technology adoption, especially for organizations at the early stages of the digital journey or with limited access to resources, knowledge, and finances.
 - Availability of Training and skills development (TSD) is identified as a moderate barrier to digital adoption by approximately 43% of participants. Organizations should focus on providing training and skill development opportunities geared toward advanced tools and technologies, which can be available for both organizations and future graduates.
 - Legal/Privacy/Data Management barriers are significant, with approximately 64% identifying it as a barrier. Organizations should focus on providing training specifically developed for the selected organization on data governance principles, which PSEs, Supply Chain Canada, the government or other third parties can provide.
 - There is a moderate positive correlation between Organizational, Managerial, and Attitudinal (OMA) barriers and the Individual Commitment of the Employee to New Technologies. Policymakers should focus on addressing these factors together to ensure successful digital adoption.
 - There is also a moderate positive correlation between Information Technology/Technical Support and Availability to Implement New Digital Tools and Financial Market and Business Context Drive the Implementation of Newer Technologies at Work. Organizations should provide necessary information on the ROI, benefits, and support during the technology implementation and training process to promote digital technology implementation.

DIGITAL ADOPTION ENABLERS:

- Public/Private Funding (Exhibit 27) and Financial Incentives to Adopt Innovative Technologies (Exhibit 31) are essential enablers for organizations to implement projects related to emerging technologies
- Providing Government Sponsored Platforms Supporting SMEs (Exhibit 28) is a critical enabler. However, organizations may prefer to be independent of government platforms. This can be linked to internal funding available to the organization and the ability to control the digital implementations based on the strategic objectives and organization needs by decoupling it from any government influence.
- There is a need to increase awareness of the economic benefits of past implementations and user cases (Exhibit 29), and the government and other bodies need to offer information and knowledge (Exhibit 30) about different support programs offered by the government to enable information dissemination based on the industry sector, digital adoption journey, etc.

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- Internal capital (Exhibit 33) and market potential (Exhibit 34) are essential for technology adoption projects. Organizations must evaluate these factors before investing in expensive hardware, software, or consulting services necessary for successful technology adoption.
 - Internal/External Collaboration (Exhibit 37) is a critical enabler, and organizations must collaborate with multiple stakeholders to leverage digital technologies' full potential.
 - Technical Infrastructure (Exhibit 38), Digital Strategic Plan (Exhibit 39), Integration with Existing Systems (Exhibit 40), and Appropriate Consulting Services (Exhibit 41) are also essential enablers for technology adoption projects. Policymakers can support organizations by developing guidelines or policies to ensure these enablers are available.
 - The regulatory Environment (Exhibit 42) and Intellectual Property Protection (Exhibit 43) are critical enablers, and policymakers can develop policies and regulations to support technology adoption while protecting intellectual property rights.
 - Technological Infrastructure Development (Exhibit 44) and Investment in Research and Development (Exhibit 45) are essential enablers, and policymakers can support organizations by investing in infrastructure development and research and development.
 - Finally, digital adoption readiness assessment tools (Exhibit 46) can help organizations identify their digital adoption journey and the enablers they must focus on to succeed in their digital transformation journey. Policymakers can promote such tools and develop customized tools for specific industry sectors.

Overall, policymakers must focus on providing financial incentives, promoting awareness of the benefits of technology adoption, and developing policies and regulations to support technology adoption while protecting intellectual property rights. They can also invest in infrastructure development and research and development to support organizations in their digital transformation journey. Additionally, policymakers can promote digital adoption readiness assessment tools to help organizations identify the enablers they must focus on to succeed in their digital transformation journey.



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